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ECONOMICAL CHAMBER LOCK WITH COMPRESSED AIR CHAMBER

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(WiGB1, p. 175)

In contrast to all the known implementation forms of ship elevators and chamber locks, an attempt is made according to the invention to find a solution for the temporary storage of lock filling water so that the rising and sinking of the ship takes place as usual by rising and sinking of the water level. Thus, the water and not any auxiliary element is moved for raising and lowering the ship. In known patents the lock water is temporarily stored in side cells or reservoirs. It is now possible to use the upper level as the reservoir instead of this if the lock chamber is closed air-tight, i.e., provided with a cover so that it can withstand an air overpressure equal to the difference of the level of the upper water with respect to the lower water. Thus, this involves the production of a lock chamber to be placed temporarily under compressed air, similarly as this occurs in air pressure foundations for caissons to great depths of a maximum of 25-30 m. The lock chamber thus designed acquires a gate that closes water- and air-tight at the upper level and a similar gate on the opposite side of the lock at the lower level. The upper level is also connected with the lock chamber by pipelines that empty directly at the bottom level laterally or in the middle of the bottom and serve to return the water from the upper water to the

chamber by gravity or from the latter to the upper water by air pressure. The inlet openings of the connecting pipe from the upper water to the chamber should have upper closing slide valves that prevent the back flow of the water raised by compressed air, e.g., cylindrical valves or similarly operating simple shutoffs that close automatically under the pressure of the upper water as soon as the pressure from below stops. The air pressure in the chamber must be maximally produced equal to the upper water/lower water level difference. Of course, it is possible to design the lock with two or more stages in the case of quite great elevation heights according to the same principle, wherein the upper stage of the level always forms the reservoir for the amount of water of the next stage to be stored. If the pressure head of the accumulation stage is more than 10-15 m, the lowering of the ship will expediently take place without the crew, in which case the guidance of the ship chamber can be done most simply by vertically movable anchoring brackets or braces.

The locking process can be simple. The chamber is filled with water from the upper water through the lines described. The ship passes through the opened upper water gate and is appropriately secured in position laterally. The crew leaves the ship if the drop and thus the pressure head are too great. The upper water gate is closed and the chamber is placed under pressure so that the water escapes through the lines emptying into the bottom level towards the upper level or to the upper connecting lock. If the water level of the next lower stage is reached, normal atmospheric pressure is produced in the lock chamber, the lower gate opens and the ship is locked into the lower water channel or into the next lock chamber.

The ship is raised in precisely the reverse sequence, where it is sufficient for filling to open the slide valve of the connecting lines to the upper water or to the upper-lying lock stage, after the closure of the lower water channel was previously closed after the entrance of the ship.

Just as several lock stages are arranged under each other, two or more chambers can also be arranged laterally together, with the advantage that the raising of the ship takes place in one chamber and its lowering in the second one, by which less than half the work for raising the water level is required.

If only one ship is to be locked, the chamber of the second lock forms the water reservoir for the operation of the first one and the power consumption is twice as much.

The individual forms of the lock arrangement are shown schematically in the drawings.

Figures 1 and 2 show a lock with one stage.

Figure 3 shows one of three stages.

Figure 4 shows the cross section of a double lock.

Of course, the solution can be combined with the lateral storage cells and the chamber with compressed air, in which case the filling of the cells takes place by a relatively low air pressure in the chamber and the holding of the water of the cells with a full lock chamber by a

correspondingly greater air pressure. This air pressure can be saved in the cells if the cells are rendered closable against the outside pressure of the water in the chamber by appropriate slide valves. These slide valves only need to be actuated in the filling of the chamber in the sequence from the bottom to the top according to the emptying of the side cells and can remain open in the emptying of the chamber or an emptied chamber.

The work output for producing the pressure difference for raising and lowering the ship is reduced if the air is pumped from the chamber to be filled into the one to be emptied, by which an accelerated filling takes place in the first one by the rarefaction and a correspondingly rapid emptying in the second one by the air compression.

The difference relative to the above-cited patents is that the lock chambers themselves are used for the moving and storage of water in connection with the upper water channel and the upper connecting lock stages. The solution is thus less expensive than those indicated hitherto because only one somewhat modified lock has to be actualized without additional structures, but reinforced so that the walls and covers withstand the air pressure of the impounded stage height.

The lock chamber is shown schematically and designated by K in the drawings; it is completely closed and connected through an air- and water-tight gate  $T_1$  with the upper water and through the gate  $T_2$  with the lower water. After the upper water gate is opened and the ship has entered, the gate  $T_1$  is closed and the air pressure is correspondingly produced, whereby the water returns from the chamber through the pipeline R into the upper water channel. The lower gate is then opened, after an air equalization had previously been effected and the ship passes out to the lower water channel. The ship to be raised passes in, the gate  $T_2$  is closed and by opening the gates in the pipelines R, water is removed from the upper water channel to fill the chamber. After the water levels are equalized, the upper gate  $T_1$  is opened and the ship moves out.

Figure 3 shows how the water movement can be regulated by a corresponding overpressure in the chamber in a flight of locks in the same manner, wherein the upper chamber or the upper level is used for storage in emptying the lower one, for  $K_3$ ,  $K_2$ , for  $K_2$ ,  $K_1$  and for  $K_1$ , the upper level.

A double lock is shown in cross section in Figure 4. The lowering of the water level in chamber  $K_2$  occurs through air pressure, which simultaneously induces the filling of chamber  $K_1$ . The closure of the chambers by gates and the locking process is otherwise conventional and possible as soon as the corresponding water levels are produced.

Of course, it is possible to design the flight of locks in double lock form, where the regulation of the water level is done in the same manner by air pressure, and possibly in combined form as described in Figures 3 and 4.

### Claims

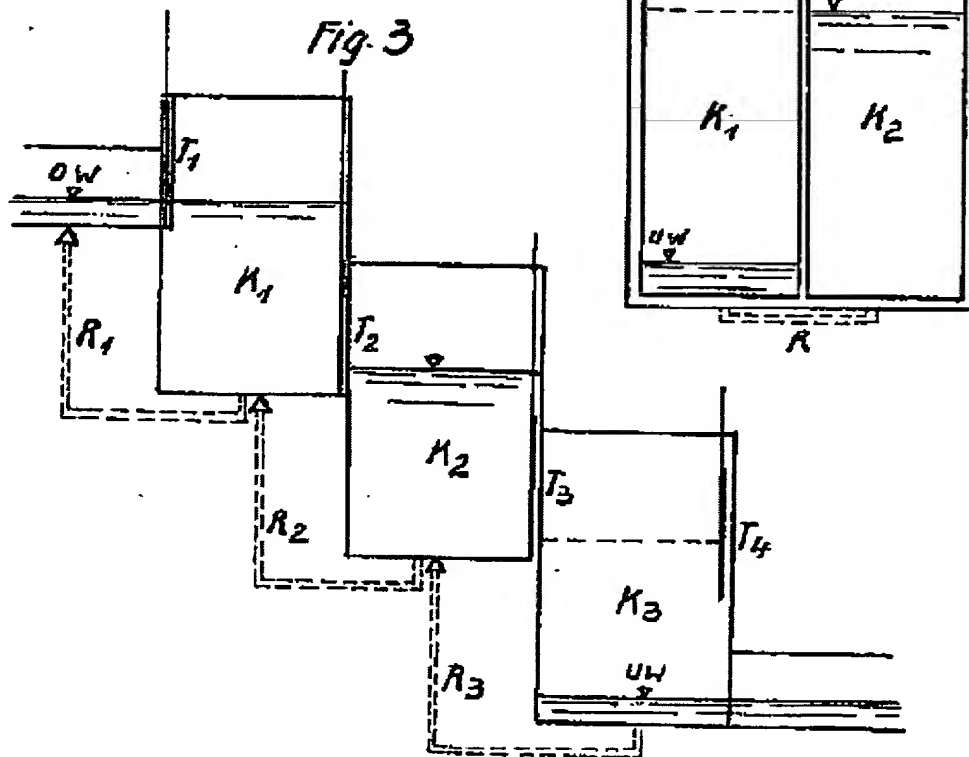
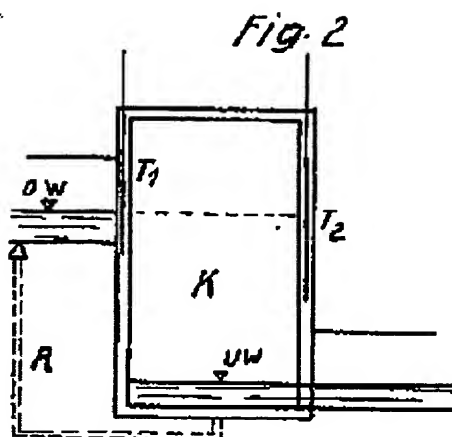
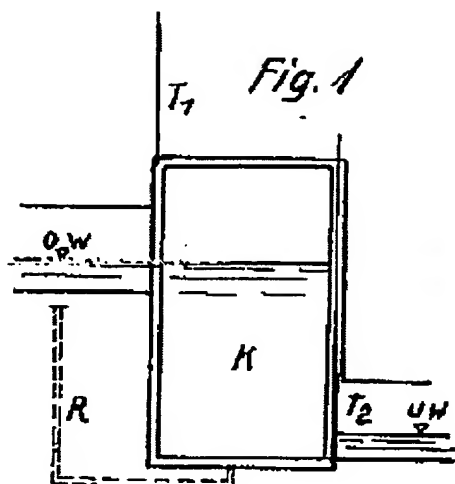
1. Economical lock chamber, characterized in that the chamber is completely closed on all sides so that it can be placed under air pressure toward the upper water and the lower water after the gates are closed.

2. Lock according to Claim 1, characterized in that the upper water is connected with the chamber through one or more channels that empty into the bottom level or the middle of the bottom and which are closed at the entrance opening in the upper water channel by cylindrical gates or the like.

3. Lock according to Claims 1 and 2, characterized in that with the corresponding opening and closing of the water- and air-tight upper water and lower water gates and the generation of air pressure in the lock chambers the ships are lowered from the upper water to the lower water, wherein the lowering of the water level takes place by compressed air in that the water escapes through the channels to the upper water channel.

4. Lock according to Claims 1-3, characterized in that with a great height of the impounded stage several chamber locks are arranged one after the other, wherein the chamber of the upper stage, beginning with the upper water channel, serves as the storage space for the water quantities forced from the next chamber during locking out.

5. Lock according to Claims 1-4, characterized in that a double lock chamber is present in a one- or more-stage lock flight, by which the simultaneous locking up and locking down of ships is possible with a significantly reduced power consumption per ship.



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